

SINUS DISEASES: THE USE OF ROENTGEN RAY IN THEIR DIAGNOSES*

By ORRIE E. GHRIST, M.D.
Glendale

DISCUSSION by Dean E. Godwin, M.D., Long Beach;
Harold A. Fletcher, M.D., San Francisco; Charles E.
Futch, M.D., Los Angeles.

HISTORY

IN passing currents from one electric pole to another, it is probable that William Morgan, in 1785, produced the first x-ray, but he certainly was not cognizant of the fact.

The first to recognize that he was dealing with these rays was William Konrad Roentgen of Würzburg, Bavaria. In 1895 this investigator was doing extensive experimental work on the passage of electric current within an evacuated tube. He first noted a strange phenomenon: in a dark room with the tube covered with light opaque material, passage of current within the tube would cause a platino barium cyanid screen nine feet away to fluoresce. During these experiments, one day he was called quickly out of the room. He happened to lay this tube on a book, which book contained a large key under which lay a photographic plate (we know now that in the older type of tubes x-rays were emitted for a time after the current was turned off). He later took a hike, during which he used this film to take a picture. On developing it he noted the outline of this key. He repeated the experiment, and again found the outline, and realized he was dealing with some ray, invisible to the naked eye, and capable of penetrating matter which was opaque to the ordinary light rays.

Because he did not recognize this ray he called it "X" ray. He later laid his hand on a plate and was the first to demonstrate bony shadows on an x-ray plate. He was also the first to show the shadows on a fluorescent screen. It is noteworthy that within a year it was being used in medicine in many places in Europe and America. Four days after its introduction in the United States a bullet in the calf of a man's leg was located.

Sheir, in 1897 (only two years after its discovery), was the first rhinologist to demonstrate that a sinus, which appeared flat on an x-ray plate, contained pus.

PROPERTIES OF ROENTGEN RAYS

Some of the interesting things about roentgen rays are as follows:

If we consider them in relation to the visible spectrum (8000 Angstrom units for red to 4000 Angstrom units for violet), we find they are of much shorter wave length (1000 Angstrom units to 0.06 Angstrom unit), and are to be located in the electromagnetic spectrum far out beyond the violet and ultra-violet rays.

They travel at the speed of light (186,000 miles per second).

They cannot be deflected by a magnet.

It was thought that they could neither be reflected nor refracted, but we now know they can be diffracted and reflected by certain crystals. Seigbahn has obtained a spectrum of x-rays, and it is on this work that the science of crystal analysis is based.

They have certain biologic effects. Depending on the amount of absorption by the cells, they will cause either stimulation, retardation in growth, or complete destruction.

They ionize gases.

Chemically, they cause certain actions: for example, they cause iodine to be freed from iodoform in chloroform.

Those properties which are of especial importance to physicians are:

1. They cause a fluorescence of a platino barium cyanid screen.

2. They affect photographic plates exactly like light rays.

3. They penetrate matter which is opaque to ordinary light, and they are inhibited from penetrating this matter in direct ratio as to its atomic weight.

This latter characteristic is of special importance because, even though x-rays do spell mystery to the layman, a harvest for the charlatan, and a glowing story for the x-ray salesman, to us they are only showing on a photographic film the differentiations in density of the parts x-rayed. This, above all points, should not be lost sight of.

APPARATUS

There are a number of different head-rests used for holding the head and getting the proper angles. No matter what type you use, there are three essentials:

(a) The head must be held exactly in the mid-line, *i. e.*, in the posterior anterior position; the head must be exactly centered in a vertical line, and the x-ray target must be exactly above this center line.

(b) The glabella-mento line must form a definite angle with the horizontal.

(c) The head must be absolutely still while the view is taken. (Check this by noting if the cancellar bone of the jaw around the teeth, etc., stands out clearly.)

We use a head-rest which Dr. D. M. Ghrist worked out a number of years ago. In our experience, it meets all three of the above requirements and can be used either with or without a Potter-Bucky diaphragm.

The nose fits into an opening in a bakelite plate. This fixes the glabella-mento line. The angle at which this plate rests can be read off at the side on an angle meter. The bar which screws the two bakelite side head holders together is a solid bar clear across, fixed at the mid-point, with threads from both sides, progressing toward the center. Thus, when this is screwed up, the head is fixed in the exact mid-line.

NOMENCLATURE

The nomenclature which eye, ear, nose, and throat specialists and the roentgenologists have in

* Read before the Eye, Ear, Nose and Throat Section of the California Medical Association at the sixty-fifth annual session, Coronado, May 25 to 28, 1936.

common is as a rule easily understood, but there is one thing which we should bear in mind, namely, that in describing the position in which a film has been taken the roentgenologist uses such expressions as posterior anterior (or P. A.), etc.

The first in this case, the "P," means that that part is nearest the tube, and the last in this case, "A," is next to the film. In asking the roentgenologist to take certain views, this point should be kept in mind, for he is able to get the best detail in the part nearest the film.

PENETRATION

The first thing to notice about an x-ray film is whether or not it has been correctly exposed, overexposed, or underexposed. This can be told at a glance. Definitely underexposed pictures are very weak and bleached out. One can see that not enough of the x-rays have gotten to the film. Definitely overexposed pictures give a slatey appearance. If either of these two latter characteristics are noted, little or no exact information as to the status of the sinuses can be obtained from reading the films.

FUNDAMENTAL SETTINGS

There are many variations as to the settings chosen by the different roentgenologists. Nowadays so many different schools are turning out x-ray technicians that it is essential for each of us to choose definite settings with which we may become very familiar, and we should know these positions well enough to ask the technician for them. As for example:

"I wish a sterio P. A. (anterior part or face next to the film) of the sinuses at the 40-degree angle, or the 23-degree angle."

It is, of course, preferable merely to say to an expert roentgenologist, "Please make a thorough sinus study"; but even then when one sees the pictures and reads the report, one must have some concept as to their angles and positions.

All settings should be in sterio, except for Granger's "G" line.

You can check the setting used in the posterior anterior positions by noting where the petrous portions of the temporal bones cut across the film.

POSITION.—Views can be taken in either the lying or upright position. In the upright position, if a sinus is partially filled with fluid of low enough surface tension, Claus has demonstrated a concave line. If this line fails to shift when the head is tilted, the sinus content is likely to be mucopurulent. Convex lines are generally polypi.

The settings which seem to get the best results in sinus studies are the following:

The Forty-Degree Angle.—Here we note the petrous bones are below the lower floor of the antrums. This position gives a good view of the antrums (except their floors), a fair view of the frontals, ethmoid areas, and if the proper type of a wooden block is used to hold the tongue down and the mouth open, a third shift of the tube gives a good view of the sphenoid cells in the open mouth.

The Twenty-Three-Degree Angle.—Here the petrous portion of the mastoids go through part

of the antrums. This gives a better view of the frontals especially.

The Seventeen-Degree Angle Below the Horizontal.—This is Granger's view, and is taken to study especially Granger's "G" line of the sphenoids. Here we also get a good view of the posterior ethmoids, and sometimes obtain information on the anterior ethmoids. This view must be accurate. The head must be carefully centered, and the resultant view will be correct only if the petrous bones pass exactly through the center of the orbits.

Verticomenal View.—This view is used very frequently in studying the sphenoids. It gives information especially as to their lateral extensions.

Lateral View.—This view in sterio often shows quite well the condition of the ethmoids, the anterior posterior limit of the sphenoids and any thickening of the floor of the frontals. Here also we especially should notice how thick the skull is, because, of course, the thicker the skull the less intrasinus detail we expect to get in our other views.

Of the above views, we use routinely the sterio of the 40-degree angle, the Granger "G" line and a sterio lateral, using the other views only as indicated.

EFFECTS DIFFERENT PATHOLOGIC PROCESSES HAVE ON ROENTGEN RAYS

In checking the changes to be noted on x-ray films, one should look for:

(a) Comparative cloudiness: for this comparison we use the inner wall of the orbit. Practically speaking, the inner wall of the orbit gives the same density as the inner portion of the normal sinus.

(b) Changes along the sinus walls, *i. e.*, changes in the thickness of the mucous membrane, how sharp the sinus walls stand out, and whether or not they are partially or totally eroded.

The pathology in the sinuses manifests itself on the x-ray films more or less clearly in direct ratio as to the amount the tissues and spaces are changed in their specific gravity.

Sinuses of Unequal Size.—The smaller shows more dense than the larger.

Edema, or water logging, as we see it in acute disease, gives a markedly fuzzy appearance; and when in the mucous membrane also causes a marked blurring of the distinctness of the sinus wall outline. This is especially noted in the posterior anterior views.

Fluids or Pus.—Make the whole sinus look generally more opaque (the higher the specific gravity of the contents the more opaque they appear). At times a fluid line is demonstrable.

Hypertrophies of the Mucous Membrane.—Shows as a thickening inside the sinus walls. As this condition becomes more chronic, and as a certain amount of osteitis progresses, the bony walls become more sharply outlined. As this further progresses, the outline becomes sharper and sharper until the bone is sometimes eroded. Polyps sometimes reveal their outline in these films. (Law.)

Cysts.—Show an increased density and a rounded and smooth outline.

Osteomyelitis.—The important thing to be remembered here is that the x-rays do not, as a rule, show changes in the structure of bone for from eight to twenty-one days after the disease process starts. This should be borne in mind when looking at mastoids; for although one may see the fuzziness of the edema, or general haziness throughout the bone, from pus or fluid, one does not expect to see changes in the structure of the bone until after the eighth to the twenty-first day. As Doctor Beck once told us in discussing osteomyelitis of the skull, "the disease is at least ten days ahead of your x-ray pictures."

New Growths.—How well do we or do we not see them depends on their effect on the bone. Those new growths which are of a bony character and take on calcium, are, of course, very readily discerned. Carcinomas show only from their effect in bony destruction. Their characteristics are that they show cloudiness of the sinus or sinuses, tend to destroy bony walls, and are much more extensive than you would expect from your x-ray findings.

In applying the aforementioned to a sinus (the antrum for example), we find:

1. Normal sinus: Sharp wall outline; no haziness of mucoperiosteum; intrasinus density that of the orbit.

2. Antrum containing fluid of low specific gravity; general dullness; duller than orbit or its fellow sinus; fluid line (sometimes); inner sinus bony wall can still be seen.

3. Pus in sinus: Marked general dullness (flat); markedly duller than orbit or its fellow sinus; inner sinus bony wall cannot still be seen.

4. Acutely inflamed: Fuzzy mucoperiosteum; fuzzy and indistinct bony outline; some opacity.

5. Chronic inflamed sinus: Hypertrophy mucoperiosteum; bony outline sharper; some opacity.

5a. In ethmoids: Sometimes can see these bony outlines sharper than usual; sometimes goes on to a break in the normal bony outline. (Law.)

6. Chronic inflamed sinus in an acute exacerbation: Hypertrophic mucoperiosteum, which appears fuzzy; bony outline quite clear; some opacity.

In the lateral view of the frontals, note the skull thickness. In this view you will note the presence or absence of the frontal sinus. In the absence of the frontals you should see cancellous bone in their place. No amount of pus or granulation tissue will obstruct them in the lateral view.

Note ethmoids especially in this lateral view. If the small cell-wall lines are fragmented, absent, or stand out with exceptional sharpness, it indicates involvement (chronic).

Sphenoid:

Lateral view: This view shows its anterior posterior size. In this view if you see a fuzziness of the anterior sphenoidal wall, this may be just a pathologic condition in the posterior ethmoids.

Verticomenal view: This view shows you best the lateral edges and lateral extensions; also shows

mucoperiosteum thickenings and general dullness or haziness at times. Granger, however, points out that this view (a) does not have positive and readily identified boundary marks; (b) that you cannot make perfect duplicates; (c) that either polyps, a marked hypertrophy of the inferior turbinate or a carcinoma may cause a normal sphenoid cell to appear cloudy.

Granger's "G" line position: This is a view of the upper border of the sphenoid, and it can show any one of the general sinus changes already noted. We find it one of the most important views. Granger states that, with this view, 95 per cent of the sphenoid sinus conditions can be diagnosed.

PROCEDURE IN EXAMINING PICTURES

1. Was the picture over- or underexposed?
2. Was the picture taken at the correct angle? Was head fixed? (Note: Mastoid bones and cancellous bone about the teeth.)
3. Anatomy: In lateral view, note skull thickness. In posterior anterior view, note relative size of sinuses.
4. General density (orbital comparison) (sometimes the reducing glass accentuates this): Fluid, pus.
5. Study mucoperiosteum. Is it fuzzy? Is there any hypertrophy? Are there polyps to be seen?
6. Study bony walls. Are they fuzzy? Is there any increased sharpness? Has there been any or a total erosion?

WHEN SHOULD WE USE ROENTGEN RAYS

They should never be used as the only method of diagnosis of sinus disease. There is a great tendency of the general practitioner, when he suspects sinus trouble, to have one flat view of the sinuses taken, in order, in his mind, to rule out all sinus disease. This should be discouraged, and the general practitioner taught that there is no easy road to the diagnosis of sinus disease.

A glance below at an outline of the study of sinus disease will show that in discarding all but x-rays, we would be bound to have a high percentage of error.

Diagnosis of Sinus Pathology:

History
Direct examination
Transillumination
X-rays
Laboratory data:
Wassermann
Smears
Fluid
Examination
Blood counts, etc.

We, therefore, must relegate x-rays to their proper place. In keeping the above outline in mind, one can see x-ray is only one phase in the diagnosis, and we must never forget that the x-ray films only show changes in the specific gravity of the tissues and sinus contents, nothing more.

However, these changes in density are often very helpful to us, and in certain conditions it seems that it would be wise for us to refer more patients for x-ray study before giving a negative report on their sinus condition. As an example: I have checked one hundred consecutive cases in an arthritis clinic in the Los Angeles County

Hospital, x-raying all of them, and it is interesting to note two things:

First: That thirty of these patients (30 per cent) showed sinus pathology in their films.

Second: That nine of these patients showing sinus pathology on their films gave *no* history of any sinus disease, which might have led me or the general practitioner to suspect sinus trouble.

As you see here, I have often been surprised to find sinus pathology where I did not suspect it from my history and examination.

Especially in the following group of cases x-rays should be taken:

1. Practically all sinus cases before operation.
2. Before making a negative diagnosis in cases being surveyed for focal infection.
3. Chronic discharging ears.
4. Postinfluenza patients not doing well.
5. Chronic bronchitis.
6. Patients suffering from colds persisting after tonsillectomy.
7. Upper toothache when teeth are negative, from dental point of view.
8. Before septum operation when patient complains of anything but occlusion.
9. Cases with high-arch palate and mouth breathers.

IN CONCLUSION

In conclusion, I advise more exact study of exposures and positions, making certain they are correct. The anatomy of the sinuses should be observed.

In general, fuzzy borders show an acute condition, sharper bony outline with thickened mucoperiosteum shows a chronic state, and general haziness indicates fluid or pus.

In osteomyelitis, or when looking for bony structural changes, one should remember that the disease is about eight to twenty-one days ahead of any visible changes to be found on the x-ray film.

Bearing in mind the relative place of x-rays in the field of diagnosis and their physical properties, one will neither expect too much nor too little of them.

143 North Brand Boulevard.

DISCUSSION

DEAN E. GODWIN, M. D. (820 Professional Building, Long Beach).—To the layman, the x-ray, because of its magic and weird properties, represents the possibility of solution of all his uncertainties and ills, and he expects an x-ray picture to give a ready-made diagnosis to any obscure condition much as he would get in a prediction of his "fortune," from a slot machine. Too often a hurried or lazy physician assumes the same attitude, and expects the roentgenologist to solve his problems and do his thinking for him.

Doctor Ghrist has properly evaluated the roentgenogram, making it but one of the several methods of arriving at a diagnosis in sinus conditions, and I note that in his "outline of the study of sinus disease," he puts the x-ray after the history, clinical examination, and transillumination. In many cases, after these are done, the diagnosis is so obvious that the roentgenogram can be omitted. In other cases, when the condition is more obscure, the picture may be the deciding factor in arriving at the diagnosis. Even when the diagnosis is complete without it, a picture is often invaluable from an anatomical standpoint before surgery of the sinuses, particularly the frontals and sphenoids.

Doctor Ghrist has given us some valuable guides in interpreting the x-ray films, and infers, of course, that the rhinologist should study and attempt to diagnose his own films. This is as it should be, for the clinician has the advantage over the laboratory man in that he can check his findings and interpretations at surgery, and thus improve his diagnostic abilities.

In my opinion, this subject should not be closed without mentioning the value in certain cases of the uses of lipiodol by the Proetz method or by injection, as this may show thickening of the mucous membranes, or polypsos that are not shown by the ordinary methods. Another point that may be spoken of is the value in certain cases of making the exposures while the patient is erect, with the x-ray horizontal to show fluid levels.



HAROLD A. FLETCHER, M. D. (490 Post Street, San Francisco).—Many roentgenologists are apt to make pathologic diagnoses in reporting their findings from their x-ray examinations. These pathologic diagnoses are often found not to fit in with the clinical picture present. To a physician or a nose specialist who has not taken the time to familiarize himself with reading his own x-ray films, these reports, often accepted verbatim, start the physician and patient off on a completely false path of expensive, painful, and time-consuming treatments and operations. The roentgenologist is still much too anxious to make far too reaching positive diagnoses based solely upon his examination, instead of reporting facts of abnormal changes of density which is all he can accurately do. When he has carefully and accurately recorded his findings, it is quite reasonable for him to suggest the possibilities of the underlying pathology if he knows them.

Many general physicians, general surgeons and (unfortunately, and to their discredit) many rhinologists accept an x-ray report of, for instance, a "cloudy maxillary sinus" and, with hardly a cursory glance at either the x-ray film or the patient, advise a radical antrum operation. This is bad medicine, bad surgery, and certainly suspiciously bad rhinology.

If the various departments of medicine and surgery are going to utilize x-rays in the diagnosis of sinus diseases, they owe it to the patient and to their profession to use them intelligently. Hearing an abnormal chest sound through a stethoscope is not an indication for a rib resection, no matter how remunerative, and similarly it may be said that cloudiness and other x-ray findings in sinus pictures are not of themselves indications for sinus surgery. The abnormal findings by x-ray are sometimes of great help when fitted into their proper place with the other clinical observations. Far too much importance, however, has been attached to these findings alone.

This article is for its purpose quite complete. It points out, in the first place, what one should expect to find in a well-taken film. It points out that, unless a picture is well taken and clear, it is worse than useless to attempt diagnosis from it. It points out the various positions most useful in x-ray studies, and the various findings indicative of pathology, and it finally places the usefulness of x-ray diagnosis in sinus condition in a proper relationship. It is a paper well worthy of careful and intensive study and thought by the general practitioner, surgeon, and rhinologist.



CHARLES E. FUTCH, M. D. (1930 Wilshire Boulevard, Los Angeles).—The historical and physico-chemical analysis in Doctor Ghrist's paper is of particular interest to the rhinologist, affording him a review which can only result in a better interpretation of his films.

James T. Case said: "It is too much to expect any man to be a specialist in all of the branches of medicine in which roentgenology plays a useful part." This is only too true, but it is entirely essential today that the rhinologist should have a clear understanding of x-rays of sinupathology, if he is to diagnose and treat these conditions.

Doctor Ghrist's suggested technique and nomenclature, if generally adopted, would go far toward righting some confusion which still exists in this field and thus assist in what is essential in all scientific work, namely, establishing a common basis of technique for universal study

and comparison. It is hoped that some such standardization will be nationally adopted.

Only emphasis can be laid upon the point already stressed by the author relative to stereoscopic films. Such films are essential to a proper interpretation, particularly in the complex ethmoid labyrinths and sphenoid cells. The remarkable anatomical variation in these cells is well known, and only by stereoscopic view can we expect to interpret pathology. The exactness of knowledge necessary to successful surgery of these regions is greatly fortified by stereoscopic study.

The author correctly states that in the diagnosis of sinus disease an entire reliance upon the x-ray would result in a high percentage of error, but there were certain instances which lack of space and time prevented him from mentioning. Particularly in children where instrumentation, and even a careful examination is difficult or impossible, x-rays are a welcome and very helpful short-cut.

As the x-ray may help, so may it deceive if certain facts are not kept in mind. Proetz and others have carried out experiments showing the extreme deception that may take place in x-rays of allergic membranes. This factor of possible error, namely, the differentiation between true hypertrophy and allergy, must be kept in mind.

Osteomyelitis of the frontal bone presents exceptional difficulty upon occasion, even in stereoscopic films. As stated my Doctor Mosher: "If there is bone necrosis, the bone is infected for an inch to an inch and one-half beyond this area, and the x-ray is not positive until necrosis occurs seven to ten days later," only emphasizing again the point brought out by the author under "osteomyelitis."

RECONSTRUCTION OF THE BREAST*

By HOWARD L. UPDEGRAFF, M.D.
Hollywood

DISCUSSION by William S. Kiskadden, M.D., Los Angeles; Gerald B. O'Connor, M.D., San Francisco; Harry M. Blackfield, M.D., San Francisco.

EVERY surgeon is faced with the necessity of giving advice regarding surgery of the hypertrophied breast. If the hypertrophy is associated with malignancy, we advise radical amputation. If it is a benign overgrowth, what have we to offer the patient?

The past twenty-five years have produced an increasing number of articles on surgery of the benign hypertrophied breast. The great majority of these have come from abroad, while the American literature has been limited to a scant half-dozen. We have copied foreign operative technique, modifying it slightly and accepting its bad as well as good points.

INDICATIONS FOR SURGICAL RECONSTRUCTION

The indications for surgical reconstruction of the nonmalignant breast are necessarily based on such factors as enlargement, difference in size, lumpiness, pain from weight, interference with occupation, and mental instability arising from inferiority complexes due to embarrassment in carrying on ordinary social activities, etc.

Breast surgery should always be authorized by a very definite reason, either physical or mental, or the end-results will not be acceptable to the patient.

* Read before the General Surgery Section of the California Medical Association at the sixty-fifth annual session, Coronado, May 25-28, 1936.

ETIOLOGIC FACTORS IN BREAST HYPERTROPHY

Etiologically there is no generalization which will cover hypertrophy of the breast. One of the most generally accepted causative factors is the wearing of tight brassieres in early life, which cause atrophy of the supporting muscles and suspensory ligaments, with an impairment of the return circulation and consequent fatty deposits. There are also those instances where the body metabolism and the endocrine hook-up is such that there is a localized enlargement of the breast, either *per se* or as a part of the general overgrowth.

DETERMINATION OF BREAST SIZE

The correct size of the breast to be reconstructed is formulated somewhat upon the mental image which comes to the surgeon once the normal nipple locus has been placed. Durer, in his book on "Human Proportions," in 1528 presented a series of sketches of female figures and their measurements which have been a standard for artists ever since. Granted that the nipple normally is over the fourth inner space, Durer locates it by dropping lines from the acromioclavicular joint to the umbilicus and places the nipple where this line crosses the fourth inner space. Today the age and wishes of the patient are also important factors.

There has been, as with a number of other newer surgical procedures, a great deal of controversy as to the merits of mastopexy, or breast-shift. The greatest objection to the simple breast-shift has been the possible loss of function, which is not to be dismissed lightly. However, the fact that 80 per cent at least of our hospital postpartum patients are non-nursing mothers, is enlightening. It must be noted in passing that none of the operations described in the literature are dedicated to restoring function. Neither is the average patient seeking breast reconstruction particularly interested in preserving function in an already semi-atrophic breast.

MALIGNANCY AND NON-MALIGNANCY

The question of a differential diagnosis between malignancy and non-malignancy of the breast is one which has been thoroughly discussed in the literature. In passing, however, a recent article by Rodman states that if a patient under thirty-five has a lump in the breast which does not change for two months, he recommends local excision for microscopic study. If over thirty-five and the same situation, amputation is advised; because one-fifth to one-fourth of women over thirty-five, and especially over forty-five, develop carcinoma following chronic cystic mastitis.

Lumps in the breast, however, are mechanical obstructions to breast reconstruction and must be recognized as potentially influencing the character of operation best suited to the patient's condition.

THREE TYPES OF NON-MALIGNANT BREAST

From the surgeon's standpoint there are three types of non-malignant breast in considering reconstruction:

1. The moderately enlarged breast free from lumps that a simple mastopexy, without a lower